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U.S. Bureau of Fisheries

Work of the Bureau of Fisheries and its...

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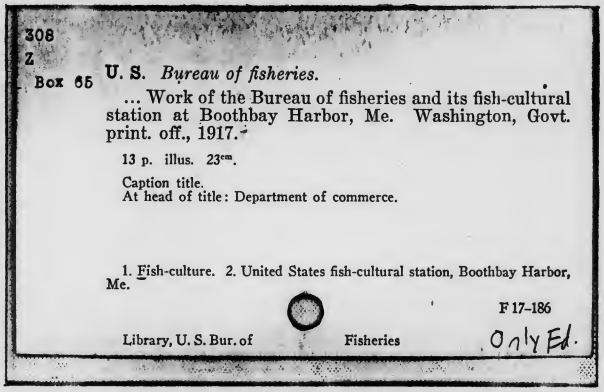

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DEPARTMENT OF COMMERCE
BUREAU OF FISHERIES
HUGH M. SMITH, Commissioner

WORK OF THE BUREAU OF FISHERIES AND ITS FISH-CULTURAL STATION AT BOOTHBAY HARBOR, ME.

The United States Bureau of Fisheries was instituted in 1871 by the passage of a joint resolution of Congress creating the office of Commissioner of Fisheries, to be filled by a civil officer of the Government having scientific and practical knowledge of the fisheries, who was to receive no additional compensation. Prof. Spencer F. Baird, then Assistant Secretary, afterwards Secretary, of the Smithsonian Institution, was appointed to the office and served until his death in 1887. By that time the duties of the position had become so

Fish-cultural Station at Boothbay Harbor, Me.

heavy as to demand the entire time and attention of the Commissioner, and soon after the office was divorced from other governmental work and accorded an independent status and salary.

Until 1903 the organization was known as the United States Fish Commission, and was responsible directly to Congress, but in that year it was made a bureau in the new Department of Commerce and Labor, now the Department of Commerce. As originally constituted

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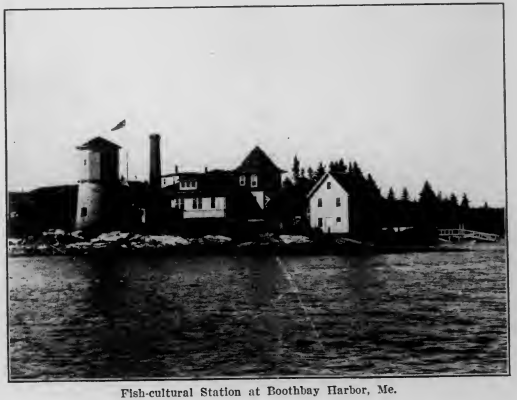

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Until 1903 the organization was known as the United States Fish Commission, and was responsible directly to Congress, but in that year it was made a bureau in the new Department of Commerce and Labor, now the Department of Commerce. As originally constituted

it was an institution for investigating the condition of the fisheries in respect to their alleged depletion, the causes which may have led to their impoverishment, and the means by which they might be conserved and their productiveness increased. As a result of the scientific and statistical investigations, the Commissioner soon determined that certain fishes had decreased and was able to recommend an efficient means for bringing about an increase or at least arresting further depletion. This was to be accomplished through the agency of fish culture, and little time was lost in securing for the project the sanction of Congress by an appropriation.

In 1872 a few salmon and shad were hatched and planted, and by 1880 eight species of fishes, including three salmons, two trouts, shad, whitefish, and carp, were being produced on a comparatively large scale, and active experiments were being conducted to determine the methods best suited to the propagation of other species.

In 1884 there were 16 fish-cultural stations in operation, and the output for that year approximated 140,000,000 fish and eggs. In 1914, 36 permanent stations and 94 subsidiaries, 130 in all, were being operated. The main stations, located in 34 States and Alaska, may be classified as follows:

	Number.
Atlantic rivers, for salmon, shad, striped bass, yellow perch, and white perch	4
Pacific rivers, for salmon and steelhead trout	5
Great Lakes, for whitefish, cisco, lake trout, and pike perch	4
Interior waters, for bass, sunfish, crappie, trout, etc	20
Atlantic coast, for cod, haddock, pollock, flounder, and lobster	3
Total	36

At these stations 45 species of marine and fresh-water fishes were propagated in 1914 and the output for that year constituted over four and one-fourth billions of fish eggs, fry, fingerlings, and adult fish, the distribution of this product concerning practically every State in the Union and the Territory of Alaska. Some idea of the magnitude of this distribution may be gained by noting the fact that during that year it involved 611,691 miles of travel, of which 131,156 miles were covered by the Bureau's special cars and the remainder by detached messengers.

In addition 2,500,000 food and game fishes were rescued from overflowed lands, where they were in peril of being left by the receding waters, and returned to the safety of the streams.

Solely by reason of these fish-cultural operations, supplemented by similar activities on the part of the States, the supply of trout and other food and game fishes in streams and small lakes is being maintained if not increased; the whitefish of the Great Lakes is holding its own, the shad in certain waters is being saved from extinction, and the effects of heavy fisheries for the Pacific salmons and certain marine species are being compensated for. It is believed that the recently inaugurated propagation of fresh-water mussels will relieve the prospect of a depletion of the supply of raw material of the pearl-button industry.

An important branch of the fish-cultural work of the Bureau has been its efforts in the acclimatization of important food fishes. As a result of these efforts the Atlantic shad and the striped bass are now abundant on the Pacific coast, and large numbers of the former species are being shipped back at the present time for supplying eastern markets. The steelhead trout, a valuable food fish indigenous to Pacific coastal streams, has been successfully introduced in some of the Great Lakes and their tributaries, the species having become so well established in Lake Superior that a fishery of considerable extent has been built up and is steadily growing in importance. Along this same line of endeavor the Bureau has for some years been transferring carload lots of the New England lobster to the Puget Sound region of the Pacific coast. It is also annually transferring to the New England stations for development large numbers of eggs of one of the important Pacific salmons, and planting the newly hatched fry in suitable waters, with the view to establishing the species in some of the Atlantic coastal streams.

The fry hatched from eggs of the commercial species, which are produced by hundreds of millions, are liberated on the natural spawning grounds from which the eggs were collected. The various species of trout, the black basses, crappie, sunfish, catfish, etc., are utilized for stocking virgin waters and for restocking waters in which the supply has become depleted.

Because of the great increase in the cost of living the people of the States, especially the farmers, are manifesting great interest in the cultivation of fish in artificially constructed ponds and in natural inland waters of limited area. The Bureau is making special efforts to cooperate in this work, and upon application will undertake to furnish fish of suitable species for stocking waters of that nature. It will also supply information regarding the construction of ponds and economical methods of management.

The statistical work, inaugurated as a necessary part of the original functions of the Bureau, has been continued and enlarged Periodical canvasses are made of the fisheries, usually by geographical sections, e. g., New England States, Middle Atlantic States, South Atlantic States, Gulf States, Pacific Coast States, Mississippi River and tributaries, Great Lakes, minor interior waters, and Alaska. In the last few years unusually comprehensive statistical reports have been published on the oyster, menhaden, lobster, and fresh-water mussels. This statistical information is not only of im-

mediate interest to the fisheries industries, but is highly important as a basis for determining the necessity and the measures for the regulation and conservation of the fisheries.

The regulation of the fisheries, whether in navigable waters or not, is a function of the government of the several States within which they are located, and until recently the Bureau of Fisheries had no executive duties in the enforcement of fishery regulations, although through its advisory capacity exercising large influence over fishery legislation. It is now charged, however, with the enforcement of the laws relating to the fisheries and the taking of fur-bearing animals in Alaska, and has entire administrative control of the Pribilof Islands, their native inhabitants, and the fur-seal herds which resort to these islands during the breeding season. The annual value of the fishery products of Alaska is about $20,000,000, or over two and one-half times the original cost of the Territory to the United States.

The scientific work for which the Bureau was originally created has grown greatly in quantity and scope. It embraces a study of the habits, distribution, diseases, and classification of fishes and other aquatic animals, especially those of commercial importance, and of their foods and enemies. As any organism is controlled more or less by its environment, the study of a commercial species involves investigation of the other animals and plants with which it is directly or indirectly associated, and of the physical and chemical characters of the waters in which it lives. The information necessary as a basis for the conservation and improvement of the fisheries, therefore, covers a wide field in aquatic biology, physics, and chemistry, and the scientific work of the Bureau is governed by an appreciation of these requirements.

The results of investigations are not always susceptible to immediate practical application, and to make them commercially valuable a considerable part of the Bureau's work consists of experiments to develop methods by which they can be applied to the needs of humanity.

Investigations and experiments are conducted by "field parties" working in all parts of the country, at the general laboratory in Washington, the marine biological stations at Woods Hole, Mass., and Beaufort, N. C., and the biological station on the Mississippi River at Fairport, Iowa. For marine investigations the Bureau has an able seagoing steamer, a coastwise steamer, and a fishing schooner with auxiliary gasoline engine power, and various launches and small boats are employed both on the coast and in interior waters. In addition to the small permanent scientific force, which is inadequate to meet the demands, the Bureau employs temporarily a large number of qualified investigators and assistants connected with universities, colleges, and other institutions of learning. Some of the

practical scientific aid which the Bureau has extended to the fisheries in recent years consists of the location of new fishing grounds; the development of markets, and means of using wasted or neglected fishery resources; the development of methods of sponge, terrapin, and fresh-water mussel culture; causes of disease in fishes; surveys of oyster bottoms, and recommendations for their conservation and utilization; recommendations for State fishery legislation, etc.

The results of the work of the Bureau are published in two series, the "Report," of which there are 40, and the "Bulletin," of which 40 bound volumes have been issued. There is also available, in pamphlet form, information explaining the methods pursued by the Bureau in the artificial propagation of various species of fish. These pamphlets and the pamphlet separates of the papers, included in the reports and bulletins, are furnished at a price representing the actual cost of presswork and paper, on application to the Superintendent of Documents, Washington, D. C., who will furnish price list to applicants.

A recently established series of "Economic Circulars" gives information on subjects of economic interest. These circulars are distributed free to interested persons on application to the office of the Bureau of Fisheries, Washington, D. C.

THE BOOTHBAY HARBOR HATCHERY.

LOCATION AND ESTABLISHMENT.

The establishment of a fish-propagating station on the Maine coast was authorized by an act of Congress in 1901, and an appropriation of $10,000 was provided for making preliminary investigations and for the purchase of a desirable site. After careful investigation had been made at several proposed points it was decided that Boothbay Harbor presented all the requisite natural features for the foundation of a hatchery of this character, the location being central, the harbor unsurpassed, and pure sea water of a proper density for the prosecution of marine fish-cultural work could be readily obtained in the harbor. Subsequent appropriations were made by Congress from time to time for completing the station in its present form.

The station reservation, consisting of approximately 10 acres of land, is located at McKown Point, on the southwest side of Boothbay Harbor, 3½ miles from the town of Boothbay Harbor. A daily boat plies between that town and Bath, Me.

The purpose of the station was primarily for the propagation of the lobster, the object being to increase or at least maintain the status of these valuable fisheries on the coast of Maine, which is the largest lobster-producing State in the Union. Much attention is also given,

however, to the propagation of the cod, haddock, and flatfish, or winter flounder, and such work is supplemented by distributions of pollock fry, which are hatched from eggs transferred from other stations.

The work of providing suitable fish-cultural facilities and constructing the special buildings constituting the plant was begun in the summer of 1903. The station was practically completed in the fall of 1904, and fish-cultural operations were undertaken in 1905.

DESCRIPTION OF BUILDINGS AND HATCHING FACILITIES.

The buildings on the reservation consist of a hatchery, boiler and pump house, storehouse and carpenter shop, fuel house, ice house, and four residence buildings for the occupancy of station employees. The hatchery is a frame structure, 48 by 70 feet, one and one-half stories high, with hip roof and tower extension 11 by 18 feet on the north side. It rests on a foundation of stone and concrete; the walls extend to the height of the window sills. The building contains a large and well-lighted hatching room on the first floor, an office, one sleeping room in the second story of the tower, and ample storage facilities in the loft. It is lighted by acetylene gas and heated by steam.

The hatching room is equipped with 12 standard cod-hatching tables of 9 boxes each, 2 flatfish tables of 13 boxes each, 14 lobster-hatching tables 16 feet long, and 2 flatfish retaining tables 10 feet by 9 inches by 3 inches. The capacity of the hatchery is 150,000,000 cod eggs, 300,000,000 lobster eggs, 700,000,000 flatfish eggs, 100,000,000 haddock eggs, and 200,0000,000 pollock eggs.

The pump house is equipped with three steam boilers, two of 15 horsepower and one of 50 horsepower, and two water pumps of a capacity of 300 gallons each per minute. Water supplying the hatchery is pumped from the harbor into a tank having a capacity of 7,500 gallons, which is elevated on a stone and cement tower 19 feet 6 inches in height. From this tank the water is distributed through pipes by gravity to points where it is needed for fish-cultural purposes.

The station is provided with substantially constructed wharves, numerous floats, live cars, and other facilities for conducting fish-cultural operations, and is equipped with a seagoing vessel, the *Gannet*, two gasoline motor boats, and a number of smaller boats. The *Gannet* is specially equipped with a commodious lobster tank built in the after part of the hull and connected by pipe lines with the pumps, so that a constant change of sea water can be supplied to the live adult lobsters and the fry and eggs of the various species of fish while being transported.

One of the most important features relating to lobster culture at this station is a large lobster pound located in Johns Bay at Pemaquid, Me., a distance of 10 miles from the main station. This pound, which has a capacity of 20,000 adult lobsters, is made of two dams bulit of concrete, stone, and earth, 14 feet wide and 160 and 140 feet long, respectively, with tank covers made water-tight to a point 2½ feet above mean high-water level. Over the dams and resting thereon is a grating of scantling and seven-eighths inch iron rods 6 feet high to prevent the escape of the lobsters. The dams are provided with two 30-inch gate valves through which the pound is supplied with water by the ebb and flow of the tides. About the

Pound for holding lobsters at Pemaquid, Me.

head and sides of the inclosure is a retaining wall 4 feet wide, covered with a wooden grating to prevent the embankment from washing and to keep the lobsters in the deep water. A six-room cottage is provided for the occupancy of the custodian of the pound, whose duty it is to care for and feed the lobsters.

LOBSTER PROPAGATION.

The propagation of the lobster is the feature of the work at this station, and in recent years the output of lobster fry has averaged about 160,000,000. The majority of the egg-bearing lobsters used by the Bureau for propagating purposes are secured, during the

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Female lobster with eggs.

their eggs are nearly matured. When this period arrives in April the lobsters are removed from the pound and taken to the Boothbay Harbor station, where their eggs are stripped off by scraping them from the swimmerets with a blunt-edged knife. The eggs are then measured in a glass graduate and placed in hatching jars, where they remain until hatched. The basis of measurement is an ounce, which contains about 6,000 eggs. After being relieved of their eggs the

lobsters are turned over to the commercial dealers in exchange for berried lobsters, while those which have become emaciated or crippled during the period they were held in the pound are liberated in the ocean.

The eggs are hatched in the McDonald automatic hatching jar, a cylindrical glass vessel of 7 quarts' capacity with hemispherical bottom, supported on three glass legs and provided with a hermetically sealed glass top, through which pass movable glass tubes one-half inch in diameter. The tubes through which the water supply passes are pressed down to within one-half inch of the bottom of the jar, while the overflow tube is inserted in the jar only an inch or so below

Tables equipped with automatic tidal boxes for hatching cod eggs.

the metal cap. Thus under pressure the water enters at the bottom of the jar and overflows near the top, causing a gentle upward and downward motion of the eggs. From 400,000 to 500,000 eggs, equivalent to about 2½ quarts, are placed in each jar, which are ranged in rows on specially constructed tables. When the eggs hatch the fry are carried with the current of water through the overflow pipes from the hatching jars into cylindrical glass aquaria, which are covered with cheesecloth to prevent the escape of the fry.

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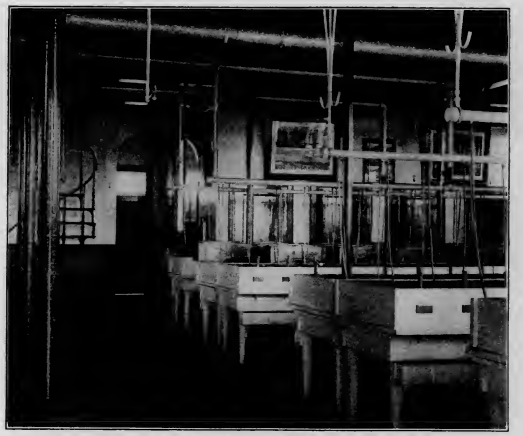

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able loss, therefore they are distributed as soon as hatched. The period of incubation depends entirely upon the age of the eggs when collected. Eggs taken in October do not hatch until the following May, whereas the eggs that are taken in June frequently hatch within 24 hours after being placed in the jars.

COD PROPAGATION.

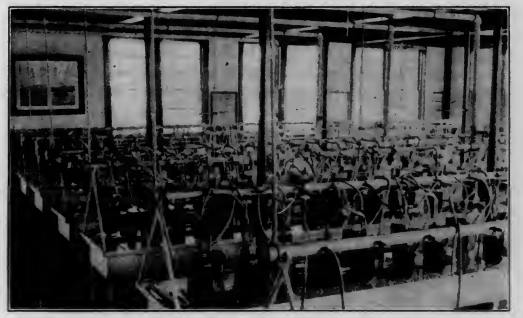
Owing to the comparatively small catch of cod on the Maine coast, operations with this species at the Boothbay Harbor station are conducted only on a limited scale. The eggs are secured from fishermen operating off Cape Elizabeth and in Casco Bay. Expert spawn takers are taken aboard the Government vessels and transported to the fishing grounds. As the nets are hauled in they are carefully

Stripping eggs from female lobsters for artificial propagation.

examined by these men and the fish which are ripe are selected for stripping.

In the stripping process the spawn taker grasps the female fish near the tail with his left hand and places the head between his left arm and body; the belly is directed downward. With the thumb and forefinger of the right hand the belly is gently pressed and stroked backward from near the ventral fin to the vent, the eggs being discharged into a moist pan. A quantity of milt is then added by treating a male fish in the same way and the contents of the pan are gently but thoroughly stirred, to insure fertilization of the eggs. Shortly after the eggs are fertilized they are thoroughly washed in sea water. They are then placed aboard the steamer *Gannet* in care of experienced messengers to give them constant attention as they are being transferred to the hatchery for development.

The apparatus now in general use for hatching cod eggs is known as the automatic tidal box. Boxes of this type are arranged on tables and each contains from 9 to 12 compartments. Each compartment has two partitions near the ends, one fixed, the other movable, and between these two partitions is a box with a scrim bottom, in which the eggs are placed. Sea water from the supply pipes is forced through rubber tubing into the small space cut off by the fixed partition and, passing through a hole in this partition and a corresponding hole in the egg box, spreads over the eggs and passes out between the eggs and through the scrim bottom. The movable partition, which does not reach quite to the bottom of the compartment, cuts off a space at the other end, in which is located a standpipe reaching not quite to the top of the compartment and covered by a cylindrical cap of larger diameter about half as long, the two



Interior of lobster-hatching plant showing jars in operation.

together forming a siphon. The inflowing water, after passing over the eggs, fills the compartment to the top of the standpipe, when it is rapidly siphoned off until the bottom of the cap is exposed and the siphon flow is broken. Thus about every seven minutes the compartments are filled and nearly half emptied, the surface of the water rising and falling like the tides of the ocean.

The spawning season of the cod on the Maine coast extends from February 15 to April 30. The eggs are about one-eighteenth of an inch in diameter, and the incubation period is 29 days in a water temperature of 33° F. About 425,000 are placed in each hatching compartment. The cod is a prolific fish, a specimen of average size producing about 500,000 eggs, while the maximum production is approximately 2,000,000.

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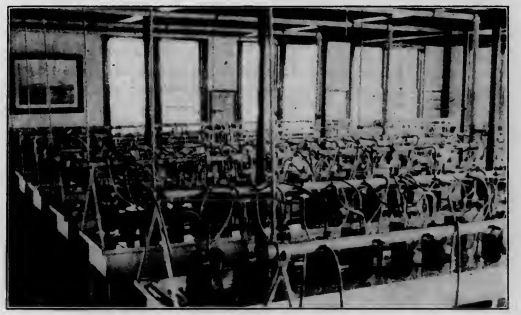

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The spawning season of the cod on the Maine coast extends from February 15 to April 30. The eggs are about one-eighteenth of an inch in diameter, and the incubation period is 29 days in a water temperature of 33° F. About 425,000 are placed in each hatching compartment. The cod is a prolific fish, a specimen of average size producing about 500,000 eggs, while the maximum production is approximately 2,000,000.

FLATFISH PROPAGATION.

Brood fish of the flatfish or winter flounder are taken by means of fyke nets set in the many coves adjacent to Boothbay Harbor, Townsend Gut, and Linekins Bay. The spawning seasons commences early in March and continues through the first week in May, with some slight variation from year to year due to local climatic conditions. Unlike those of the cod, eggs of this species do not float. When first taken they are adhesive, but tend to separate as they develop. Owing to their small size—the diameter being less than one-thirtieth of an inch—they are readily carried up by the current of water and tend to collect in masses when placed directly in the tidal boxes. To obviate this they are usually inclosed in glass jars with scrim bottom, two jars being placed in each box. Otherwise the apparatus used for the development of these eggs is similar to that employed in the propagation of the cod.

At the Boothbay Harbor station the adult flatfish are placed in retaining tables in the hatchery. The eggs from some of these fish are taken by pressure, but many are allowed to spawn naturally. In both cases the eggs are transferred to the hatching boxes soon after being fertilized.

HADDOCK AND POLLOCK PROPAGATION.

The methods of securing and hatching the eggs of the haddock are practically the same as those employed in the prosecution of the cod work. The spawning season of this species on the Maine coast usually extends from near the middle of April to about May 10. The eggs hatch in 14 days at a water temperature of 44° F.

All of the pollock fry produced at the Boothbay Harbor station are hatched from eggs shipped from the Gloucester, Mass., station. The eggs are transferred from that point, on the Bureau's steamer *Gannet*, in scrim-covered boxes placed in the well of the vessel.

DISTRIBUTION.

The many millions of fry of all species propagated at this station are widely distributed on the spawning grounds and in other suitable localities along the Maine coast, the fish being transported on the steamer *Gannet* and properly cared for en route by experienced men. In liberating the young lobsters especial care is taken to place them in sheltered waters where the natural conditions are favorable for their development. In making distributions of fry covering great distances they are carried in specially constructed boxes provided with scrim covers in the well of the *Gannet*. The fry intended for local distribution are carried in 10-gallon round-shouldered transportation cans on the deck of the boat, and when the point of deposit is reached the cans of fish, after being lowered to its surface, are carefully poured into the water.

The following table, giving the output of the various species of fish propagated at the Boothbay Harbor station from 1905 to 1914, inclusive, shows the magnitude of the operations at this station and the growth of the work during the past 10 years:

NUMBER OF LOBSTERS COLLECTED AND THE FRY OF THE DIFFERENT SPECIES DISTRIBUTED FROM THE BOOTHBAY HARBOR STATION, 1905–1916, INCLUSIVE.

Year.	Lobsters collected.	Lobster fry distributed.	Cod fry distributed.	Haddock fry distributed.	Flatfish fry distributed.	Pollock fry distributed.
1905	10,524	81,518,000	47,105,000	.....	.....	.....
1906	14,238	122,500,000	20,780,000	.....	.....	.....
1907	11,689	236,500,000	28,175,000	.....	.....	.....
1908	13,569	108,255,000	42,252,000	.....	.....	.....
1909	12,079	141,606,000	10,314,000	.....	182,070,000	.....
1910	11,908	120,900,000	14,888,000	712,000	402,165,000	.....
1911	12,265	152,295,000	8,607,000	19,139,000	437,930,000	.....
1912	14,902	188,350,000	6,230,000	11,316,000	490,169,000	.....
1913	16,965	172,000,000	5,611,000	22,967,000	413,961,000	.....
1914	20,565	175,500,000	5,859,000	894,000	556,081,000	.....
1915	18,170	193,806,200	21,841,000	974,000	394,499,000	.....
1916	18,284	128,500,000	5,516,000	.....	583,707,000	19,800,000
Total	175,159	1,719,880,200	226,178,000	56,002,000	3,460,582,000	19,800,000

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